

Practitioner's Docket No. 50261-2

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

1525 U.S. PTO  
09/330418  
06/11/99

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): **Gary N. Taylor**  
**Charles R. Szmanda**

**WARNING:** 37 C.F.R. § 1.41(a)(1) points out:

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors."

For (title): **NOVEL POLYMERS AND PHOTORESIST COMPOSITIONS**

**CERTIFICATION UNDER 37 C.F.R. § 1.10\***

(Express Mail label number is **mandatory**.)

(Express Mail certification is **optional**.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date June 11, 1999, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EI978002349US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Deanna M. Landry

(type or print name of person mailing paper)

Deanna M. Landry  
Signature of person mailing paper

**WARNING:** Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

**\*WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

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## 1. Type of Application

This new application is for a(n)

(check one applicable item below)

- ☐ Original (nonprovisional)
- ☐ Design
- ☐ Plant

**WARNING:** Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. § 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.

**WARNING:** Do not use this transmittal for the filing of a provisional application.

**NOTE:** If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

- ☐ Divisional.
- ☒ Continuation.
- ☐ Continuation-in-part (C-I-P).

## 2. Benefit of Prior U.S. Application(s) (35 U.S.C. §§ 119(e), 120, or 121)

**NOTE:** A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. § 112. Each prior application must also be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(f) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

**NOTE:** If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

**WARNING:** If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§ 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. § 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

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**WARNING:** When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application **must** be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).

- ☒ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

### 3. Papers Enclosed

A. Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

20 Pages of specification

4 Pages of claims

\_\_\_\_ Sheets of drawing

**WARNING:** **DO NOT** submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. § 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).

**NOTE:** "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. § 1.84(c)).

(complete the following, if applicable)

- ☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. § 1.84(b).
- ☐ formal
- ☐ informal

B. Other Papers Enclosed

7 Pages of declaration and power of attorney (copy of Declaration in parent case)

1 Pages of abstract

\_\_\_\_ Other

### 4. Additional papers enclosed

- ☒ Amendment to claims
- ☒ Cancel in this applications claims 9-13 and 19-20 before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)
- ☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)
- ☐ Preliminary Amendment
- ☐ Information Disclosure Statement (37 C.F.R. § 1.98)
- ☐ Form PTO-1449 (PTO/SB/08A and 08B)
- ☐ Citations

- ☐ Declaration of Biological Deposit
- ☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
- ☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative
- ☐ Special Comments
- ☐ Other

**5. Declaration or oath (including power of attorney)**

**NOTE:** A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)-(3).

**NOTE:** A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)-(4).

☒ **Enclosed (copy as filed in parent application)**

Executed by

(check all applicable boxes)

- ☒ inventor(s).
- ☐ legal representative of inventor(s).  
37 C.F.R. §§ 1.42 or 1.43.
- ☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.
- ☐ This is the petition required by 37 C.F.R. § 1.47 and the statement required by 37 C.F.R. § 1.47 is also attached. See item 13 below for fee.

☐ **Not Enclosed.**

**NOTE:** Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

- ☐ Application is made by a person authorized under 37 C.F.R. § 1.41(c) on behalf of *all* the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 C.F.R. § 1.16(e) can be filed subsequently).

- ☐ Showing that the filing is authorized.  
(not required unless called into question. 37 C.F.R. § 1.41(d))

## 6. Inventorship Statement

**WARNING:** If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

## 7. Language

**NOTE:** An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of \$130.00 required by 37 C.F.R. § 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 C.F.R. § 1.52(d).

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. § 1.52(d).

## 8. Assignment

☒ An assignment of the invention to Shipley Company, L.L.C.  
of Marlborough, Massachusetts (copy as filed in parent application)

☒ is attached. A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

**NOTE:** "If an assignment is submitted with a new application, send two separate letters—one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

**WARNING:** A newly executed "CERTIFICATE UNDER 37 C.F.R. § 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

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## 9. Certified Copy

Certified copy(ies) of application(s)

Country	Appln. No.	Filed
Country	Appln. No.	Filed
Country	Appln. No.	Filed

from which priority is claimed

☐ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 C.F.R. § 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. § 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

## 10. Fee Calculation (37 C.F.R. § 1.16)

A. ☒ Regular application

CLAIMS AS FILED			
Number filed	Number Extra	Rate	Basic Fee 37 C.F.R. 1.16(a) \$760.00
Total			
Claims (37 C.F.R. § 1.16(c))	11 - 20 =	×	\$ 18.00
Independent			
Claims (37 C.F.R. § 1.16(b))	3 - 3 =	×	\$ 78.00
Multiple dependent claim(s),			
if any (37 C.F.R. § 1.16(d))	+		\$260.00

☐ Amendment cancelling extra claims is enclosed.

☐ Amendment deleting multiple-dependencies is enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 C.F.R. § 1.16(d).

Filing Fee Calculation \$ 760.00

B. ☐ Design application  
(\$310.00—37 C.F.R. § 1.16(f))

Filing Fee Calculation \$

C. ☐ Plant application  
(\$480.00—37 C.F.R. § 1.16(g))

Filing fee calculation \$

## 11. Small Entity Statement(s)

- ☐ Statement(s) that this is a filing by a small entity under 37 C.F.R. § 1.9 and 1.27 is (are) attached.

**WARNING:** "Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. § 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).

**WARNING:** "Small entity status must not be established when the person or persons signing the . . . statement can **unequivocally** make the required self-certification." M.P.E.P., § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

(complete the following, if applicable)

- ☐ Status as a small entity was claimed in prior application  
\_\_\_\_\_ / \_\_\_\_\_, filed on \_\_\_\_\_, from which benefit  
is being claimed for this application under:

35 U.S.C. § ☐ 119(e),  
☐ 120,  
☐ 121,  
☐ 365(c),

and which status as a small entity is still proper and desired.

- ☐ A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of A, B or C above)

\$ \_\_\_\_\_

**NOTE:** Any excess of the full fee paid will be refunded if small entity status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 C.F.R. § 1.28(a).

## 12. Request for International-Type Search (37 C.F.R. § 1.104(d))

(complete, if applicable)

- ☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

**13. Fee Payment Being Made at This Time**

☐ Not Enclosed

☐ No filing fee is to be paid at this time.

*(This and the surcharge required by 37 C.F.R. § 1.16(e) can be paid subsequently.)*

☒ Enclosed

☒ Filing fee \$ 760.00

☐ Recording assignment  
(\$40.00; 37 C.F.R. § 1.21(h))  
(See attached "COVER SHEET FOR  
ASSIGNMENT ACCOMPANYING NEW  
APPLICATION".) \$ \_\_\_\_\_

☐ Petition fee for filing by other than all the  
inventors or person on behalf of the inventor  
where inventor refused to sign or cannot be  
reached  
(\$130.00; 37 C.F.R. §§ 1.47 and 1.17(i)) \$ \_\_\_\_\_

☐ For processing an application with a  
specification in  
a non-English language  
(\$130.00; 37 C.F.R. §§ 1.52(d) and 1.17(k)) \$ \_\_\_\_\_

☐ Processing and retention fee  
(\$130.00; 37 C.F.R. §§ 1.53(d) and 1.21(l)) \$ \_\_\_\_\_

☐ Fee for international-type search report  
(\$40.00; 37 C.F.R. § 1.21(e)) \$ \_\_\_\_\_

*NOTE: 37 C.F.R. § 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 C.F.R. § 1.53(f) and this, as well as the changes to 37 C.F.R. §§ 1.53 and 1.78(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(f).*

Total fees enclosed \$ 760.00

**14. Method of Payment of Fees**

☒ Check in the amount of \$ 760.00

☐ Charge Account No. \_\_\_\_\_ in the amount of  
\$ \_\_\_\_\_

A duplicate of this transmittal is attached.

*NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).*



## 15. Authorization to Charge Additional Fees

**WARNING:** If no fees are to be paid on filing, the following items should not be completed.

**WARNING:** Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

- ☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 04-1105:

☒ 37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

**NOTE:** Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☐ 37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☐ 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a)).

☒ 37 C.F.R. § 1.17 (application processing fees)

**NOTE:** ". . . A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

**NOTE:** Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

**NOTE:** 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . ." From the wording of 37 C.F.R. § 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

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**16. Instructions as to Overpayment**

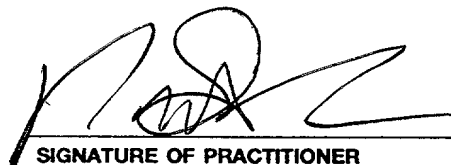
*NOTE: "... Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).*

- ☒ Credit Account No. 04-1105
- ☐ Refund

Reg. No. 33,860

Tel. No. ( 508 ) 485-7772

Customer No.



SIGNATURE OF PRACTITIONER

Peter F. Corless

(type or print name of attorney)

P.O. Box 556

P.O. Address

Marlborough, MA 01752

☒ **Incorporation by reference of added pages**

*(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)*

- ☒ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added 5

- ☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added \_\_\_\_\_

- ☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added \_\_\_\_\_

- ☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added \_\_\_\_\_

☐ **Statement Where No Further Pages Added**

*(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)*

- ☐ This transmittal ends with this page.

ADDED PAGES FOR APPLICATION TRANSMITTAL WHERE BENEFIT OF  
PRIOR U.S. APPLICATION(S) CLAIMED

NOTE See 37 CFR 1.78

**17. Relate Back**

**WARNING:** If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

(complete the following, if applicable)

☒ Amend the specification by inserting, before the first line, the following sentence:**A. 35 U.S.C. 119(e)**

NOTE "Any nonprovisional application claiming the benefit of one or more prior filed copending provisional applications must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior provisional application, identifying it as a provisional application, and including the provisional application number (consisting of series code and serial number)." 37 C.F.R. § 1.78(a)(4)

☐ "This application claims the benefit of U.S. Provisional Application(s) No(s).:

APPLICATION NO(S).:

FILING DATE

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_ "

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_ "

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_ "

**B. 35 U.S.C. 120, 121 and 365(c)**

NOTE: "Except for a continued prosecution application filed under § 1.53(d), any nonprovisional application claiming the benefit of one or more prior filed copending nonprovisional applications or international applications designating the United States of America must contain or be amended to contain in the first sentence of the specification following the title a reference to each such prior application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date and indicating the relationship of the applications. Cross-references to other related applications may be made when appropriate." (See § 1.14(a)) 37 C.F.R. § 1.78(a)(2).

- ☒ "This application is a
- ☒ continuation
  - ☐ continuation-in-part
  - ☐ divisional

of copending application(s)

- ☒ application number 08/ 963,922 filed on 11/04/97 "
- ☐ International Application \_\_\_\_\_ filed on \_\_\_\_\_ and which designated the U.S."

NOTE: The proper reference to a prior filed PCT application that entered the U.S. national phase is the U.S. serial number and the filing date of the PCT application that designated the U.S.

NOTE (1) Where the application being transmitted adds subject matter to the International Application, then the filing can be as a continuation-in-part or (2) if it is desired to do so for other reasons then the filing can be as a continuation

NOTE: The deadline for entering the national phase in the U.S. for an international application was clarified in the Notice of April 28, 1987 (1079 O.G. 32 to 46) as follows:

"The Patent and Trademark Office considers the International application to be pending until the 22nd month from the priority date if the United States has been designated and no Demand for International Preliminary Examination has been filed prior to the expiration of the 19th month from the priority date and until the 32nd month from the priority date if a Demand for International Preliminary Examination which elected the United States of America has been filed prior to the expiration of the 19th month from the priority date, provided that a copy of the international application has been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively. If a copy of the international application has not been communicated to the Patent and Trademark Office within the 20 or 30 month period respectively, the international application becomes abandoned as to the United States 20 or 30 months from the priority date respectively. These periods have been placed in the rules as paragraph (h) of § 1.494 and paragraph (i) of § 1.495. A continuing application under 35 U.S.C. 365(c) and 120 may be filed anytime during the pendency of the international application."

- ☐ "The nonprovisional application designated above, namely application \_\_\_\_\_ / \_\_\_\_\_, filed \_\_\_\_\_, claims the benefit of U.S. Provisional Application(s) No(s): \_\_\_\_\_

**APPLICATION NO(S):**

**FILING DATE**

_____ / _____	_____ "
_____ / _____	_____ "
_____ / _____	_____ "

- ☐ Where more than one reference is made above, please combine all references into one sentence.

### 18. Relate Back—35 U.S.C. 119 Priority Claim for Prior Application

The prior U.S. application(s), including any prior International Application designating the U.S., identified above in item 17B, in turn itself claim(s) foreign priority(ies) as follows:

Country	Appin. no.	Filed on
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The certified copy(ies) has (have)

- ☐ been filed on \_\_\_\_\_, in prior application 0 / \_\_\_\_\_, which was filed on \_\_\_\_\_.
- ☐ is (are) attached.

**WARNING:** *The certified copy of the priority application that may have been communicated to the PTO by the International Bureau may not be relied on without any need to file a certified copy of the priority application in the continuing application. This is so because the certified copy of the priority application communicated by the International Bureau is placed in a folder and is not assigned a U.S. serial number unless the national stage is entered. Such folders are disposed of if the national stage is not entered. Therefore, such certified copies may not be available if needed later in the prosecution of a continuing application. An alternative would be to physically remove the priority documents from the folders and transfer them to the continuing application. The resources required to request transfer, retrieve the folders, make suitable record notations, transfer the certified copies, enter and make a record of such copies in the Continuing Application are substantial. Accordingly, the priority documents in folders of international applications that have not entered the national stage may not be relied on. Notice of April 28, 1987 (1079 O.G. 32 to 46).*

### 19. Maintenance of Copendency of Prior Application

**NOTE** *The PTO finds it useful if a copy of the petition filed in the prior application extending the term for response is filed with the papers constituting the filing of the continuation application. Notice of November 5, 1985 (1060 O.G. 27).*

- A.** ☐ Extension of time in prior application

*(This item must be completed and the papers filed in the prior application, if the period set in the prior application has run.)*

- ☐ A petition, fee and response extends the term in the pending prior application until \_\_\_\_\_.
- ☐ A copy of the petition filed in prior application is attached.

- B.** ☐ Conditional Petition for Extension of Time in Prior Application

*(complete this item, if previous item not applicable)*

- ☐ A conditional petition for extension of time is being filed in the pending prior application.
- ☐ A copy of the conditional petition filed in the prior application is attached.

**20. Further Inventorship Statement Where Benefit of Prior Application(s) Claimed**

*(complete applicable item (a), (b) and/or (c) below)*

- (a) ☐ This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventor(s) in this application are
- ☐ the same.
  - ☐ less than those named in the prior application. It is requested that the following inventor(s) identified for the prior application be deleted:

\_\_\_\_\_  
*(type name(s) of inventor(s) to be deleted)*

- (b) ☐ This application discloses and claims additional disclosure by amendment and a new declaration or oath is being filed. With respect to the prior application, the inventor(s) in this application are
- ☐ the same.
  - ☐ the following additional inventor(s) have been added:

\_\_\_\_\_  
*(type name(s) of inventor(s) to be added)*

- (c) The inventorship for all the claims in this application are
- ☐ the same.
  - ☐ not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made
    - ☐ is submitted.
    - ☐ will be submitted.

**21. Abandonment of Prior Application (if applicable)**

- ☐ Please abandon the prior application at a time while the prior application is pending, or when the petition for extension of time or to revive in that application is granted, and when this application is granted a filing date, so as to make this application copending with said prior application.

*NOTE: According to the Notice of May 13, 1983 (103, TMOG 6-7), the filing of a continuation or continuation-in-part application is a proper response with respect to a petition for extension of time or a petition to revive and should include the express abandonment of the prior application conditioned upon the granting of the petition and the granting of a filing date to the continuing application.*

**22. Petition for Suspension of Prosecution for the Time Necessary to File an Amendment**

**WARNING:** "The claims of a new application may be finally rejected in the first Office action in those situations where (1) the new application is a continuing application of, or a substitute for, an earlier application, and (2) all the claims of the new application (a) are drawn to the same invention claimed in the earlier application, and (b) would have been properly finally rejected on the grounds of art of record in the next Office action if they had been entered in the earlier application." MPEP, § 706.07(b), 6th ed., rev.2.

*NOTE: Where it is possible that the claims on file will give rise to a first action final for this continuation application and for some reason an amendment cannot be filed promptly (e.g., experimental data is being gathered) it may be desirable to file a petition for suspension of prosecution for the time necessary.*

*(check the next item, if applicable)*

- ☐ There is provided herewith a Petition To Suspend Prosecution for the Time Necessary to File An Amendment (New Application Filed Concurrently)

**23. Small Entity (37 CFR § 1.28(a))**

- ☐ Applicant has established small entity status by the filing of a statement in parent application /\_\_\_\_\_ on \_\_\_\_\_.
- ☐ A copy of the statement previously filed is included.

**WARNING:** See 37 CFR § 1.28(a).

**24. NOTIFICATION IN PARENT APPLICATION OF THIS FILING**

- ☒ A notification of the filing of this  
*(check one of the following)*

- ☒ continuation
- ☐ continuation-in-part
- ☐ divisional

is being filed in the parent application, from which this application claims priority under 35 U.S.C. § 120.

(Added Pages for Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed  
[4-1.1]—page 5 of 5)



## NOVEL POLYMERS AND PHOTORESIST COMPOSITIONS

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to new polymers and use of such polymers as a resin binder component for photoresist compositions, particularly chemically-amplified  
5 positive-acting resists.

#### 2. Background

Photoresists are photosensitive films used for transfer of images to a substrate. A coating layer of a photoresist is formed on a substrate and the photoresist layer is then  
10 exposed through a photomask to a source of activating radiation. The photomask has areas that are opaque to activating radiation and other areas that are transparent to activating radiation. Exposure to activating radiation provides a photoinduced chemical transformation of the photoresist coating to thereby transfer the pattern of the photomask to the photoresist coated substrate. Following exposure, the photoresist is  
15 developed to provide a relief image that permits selective processing of a substrate.

A photoresist can be either positive-acting or negative-acting. For most negative-acting photoresists, those coating layer portions that are exposed to activating radiation polymerize or crosslink in a reaction between a photoactive compound and  
20 polymerizable reagents of the photoresist composition. Consequently, the exposed coating portions are rendered less soluble in a developer solution than unexposed portions. For a positive-acting photoresist, exposed portions are rendered more soluble in a developer solution while areas not exposed remain comparatively less developer soluble.

25

In general, photoresist compositions comprise at least a resin binder component and a photoactive agent. Photoresist compositions are described in Deforest,

*Photoresist Materials and Processes*, McGraw Hill Book Company, New York, ch. 2, 1975 and by Moreau, *Semiconductor Lithography, Principles, Practices and Materials*, Plenum Press, New York, ch. 2 and 4, both incorporated herein by reference for their teaching of photoresist compositions and methods of making and using the same.

5

More recently, "chemically-amplified" resists have become of increased interest, especially for formation of sub-micron images and other high performance applications. Such photoresists may be negative-acting or positive-acting and generally include many crosslinking events (in the case of a negative-acting resist) or deprotection  
10 reactions (in the case of a positive-acting resist) per unit of photogenerated acid. In the case of positive chemically resists, certain cationic photoinitiators have been used to induce cleavage of certain "blocking" groups pendant from a photoresist binder, or cleavage of certain groups that comprise a photoresist binder backbone. See, for example, U.S. Patents Nos. 5,075,199; 4,968,581; 4,883,740; 4,810,613; and 4,491,628,  
15 and Canadian Patent Application 2,001,384. Upon cleavage of the blocking group through exposure of a coating layer of such a resist, a base soluble functional group is provided, e.g., carboxylic acid or imide, which results in different solubility characteristics in exposed and unexposed areas of the resist coating layer.

20 Also recently interest has increased in photoresists that can be photoimaged with short wavelength radiation, including exposure radiation having wavelengths of about 250 nm or less, or even about 200 nm or less, such as wavelengths of about 248 nm and 193 nm. Such photoresists offer the potential of forming images of smaller features than may be possible at longer wavelength exposures.

25

While currently available photoresists are suitable for many applications, current resists also can exhibit significant shortcomings, particularly in high performance applications such as formation of highly resolved sub-micron and sub-half micron features.

30

For example, many current chemically-amplified positive resists require use of relatively strong photogenerated acids and/or use of a relatively high temperature post-exposure bake (PEB) treatment to conduct the desired deprotection reaction.

5        However, in many instances, use of photoacid generators that produce weaker photoacids and use of relatively low PEB temperatures (e.g. 110°C or less) would be a significant advantage. For example, if the desired deprotection chemistry could be carried out with a weaker acid, a wider range of photoacid generators could be potentially employed. Moreover, the industry continually seeks use of lowered post-  
10 exposure-bake temperatures because of uniformity considerations.

It thus would be desirable to have new photoresist compositions, particularly positive resist compositions that can be effectively imaged at short wavelengths, particularly sub-200 nm wavelengths such as 193 nm. It would be particularly  
15 desirable to have new chemically amplified positive photoresist compositions that employ photoacid generators that produce weaker photoacids and that can be activated with relatively low PEB temperatures.

#### SUMMARY OF THE INVENTION

20        The present invention provides novel polymers that contain repeating units that include acid-labile moieties that undergo a deprotection or cleavage reaction in the presence of photogenerated acid. The invention also includes photoresist compositions that comprise a photoactive component and a resin binder component that includes such a polymer with acid-labile moieties. Preferred photoresists of the invention are  
25 chemically-amplified positive resists that are imaged with deep UV wavelengths, including sub-300 nm and sub-200 nm wavelengths such as 248 nm and 193 nm.

Polymers of the invention include one or more structural groups that preferably are capable of reducing the temperature dependence of deprotection of the polymer's  
30 acid-labile moieties. That is, preferred polymers include moieties that can provide

anchimeric assistance with photoacid-induced cleavage of the acid-labile leaving groups of the polymer. Such anchimeric assistance, also known as neighboring group participation, typically involves stabilization of a carbocation intermediate generated during deprotection of the polymer's acid labile groups.

5

Preferred polymer moieties that can provide anchimeric assistance in a photoacid-induced cleavage reaction will exhibit a value, A, of anchimeric assistance that is greater than the value, A, of anchimeric assistance provided by pendant polymer moieties of  $-C(=O)O$ adamantyl,  $-C(=O)O$ norbornyl, or  $-C(=O)O$  cyclohexyl, with the same model compounds used to determine the value A of the preferred polymer moiety of the invention as well as the value A of  $-C(=O)O$ adamantyl,  $-C(=O)O$ norbornyl, or  $-C(=O)O$  cyclohexyl. The A of anchimeric assistance is defined to mean herein the value A as measured by the following rate constant ratio:

15 
$$A = \frac{k - k_0}{k_0}$$

wherein that value A is the measured anchimeric assistance; k and  $k_0$  are observed rate constants of test and model compounds respectively. The model compound is chosen to be as structurally akin to the test compound as possible. Thus for example, to determine value A for polymer moieties of  $-C(=O)O$ adamantyl, the condensation product of adamantylacrylate could be the test compound and the model compound could be the condensation product of t-butylacrylate and having approximately the same molecular ( $M_w$ ) and dispersity as the test compound of the adamantylacrylate polymer. Again, that same model compound would then be used to determine the value A for the preferred polymer moiety being considered. For a discussion of such determination of anchimeric assistance values, see N.S. Isaacs, Physical organic chemistry, ch. 13, particularly pages 646-650 thereof (2d edition, 1995, Longman Scientific & Technical, Essex, U.K.), incorporated herein by reference.

30

More specifically, pendant photoacid-labile groups that contain esters of bridged alicyclic groups will be suitable, particularly acid-labile esters of optionally substituted isobornyl. Other suitable bridged acid-labile esters include e.g. esters of fenchol, pinenol, 3,2,0 bridged-systems and 2,2,1-bridged systems. Esters of optionally substituted heteroatom-containing groups are also preferred, particularly bridged heteroalicyclic groups such as thio and oxo isobornyl and norbornyl derivatives. Also preferred are acid labile groups that are esters of optionally substituted small-ring alicyclic groups, e.g. optionally substituted cycloalkyl groups having 3 or 4 ring carbon atoms such as cyclopropylmethylene and cyclobutyl esters. Optionally substituted alkenyl esters are also preferred, particularly allyl-esters and "homo-allyl"-esters, such as alkenylesters of the formula  $-(C=O)O(CH_2)_1 \text{ or } 2-CH=CH_2$  and which may be optionally substituted at available positions.

Without wishing to be bound by theory, it is believed that such photoacid-labile esters are capable of stabilizing a carbocation intermediate generated during photoacid-induced deprotection of a polymer's acid labile groups. For example, isobornyl groups and heteroalicyclics can form a stabilized delocalized carbocation. See Schemes I, II and III below. Small-ring alicyclics and alkenyl esters can form a stabilizing allylic cation during a deprotection reaction. See Scheme IV below.

Preferred polymers of the invention are substantially free of any phenyl or other aromatic groups to provide increased transparency at short exposure wavelengths, particularly sub-200 nm wavelengths such as 193 nm. References herein that a polymer is "substantially free" of phenyl or other aromatic groups mean the polymer has less than about 3 or 4 weight percent aromatic groups, based on total weight of the polymer. Even more preferred are polymers that have less than about 1 or 2 weight percent aromatic groups based on total weight of the polymer, and still more preferred are polymers that are completely free of aromatic groups.

Polymers of the invention may suitably contain units in addition to the above-mentioned acid-labile groups. For example, polymers of the invention may contain units that are essentially unreactive under typical lithographic processing of a photoresist containing the polymer as a resin binder component. Thus, for instance, polymers of the  
5 invention include pendant substituted and unsubstituted alicyclic groups such as alicyclic groups having 5 to about 18 carbons, e.g. substituted or unsubstituted isobornyl, norbornyl, 2-methyladamantyl, cyclohexyl, etc.

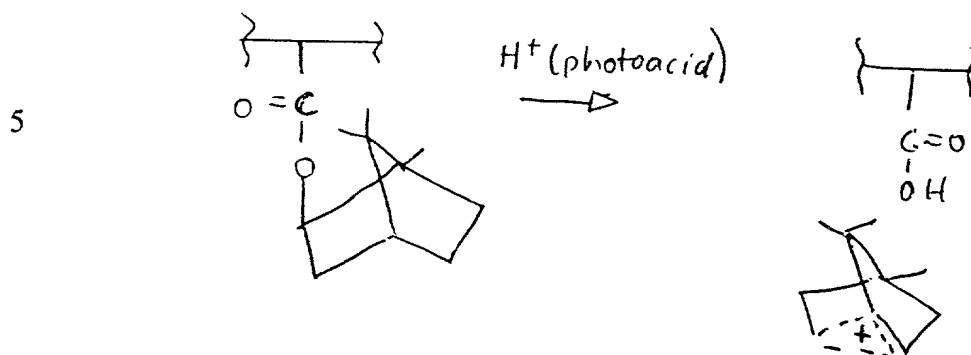
The invention also provides methods for forming relief images, including  
10 methods for forming a highly resolved relief image such as a pattern of lines where each line has essentially vertical sidewalls and a line width of about 400 nm or less, or even about 250 or 200 nm or less. The invention further provides articles of manufacture comprising substrates such as a microelectronic wafer or a liquid crystal display or other flat panel display substrate having coated thereon the photoresists and relief images of  
15 the invention. Other aspects of the invention are disclosed infra.

#### DETAILED DESCRIPTION OF THE INVENTION

As stated above, polymers of the invention in general comprise repeating units that include acid-labile moieties that undergo a deprotection reaction in the presence of  
20 photogenerated acid. The repeating units contain structural groups that are capable of reducing the temperature required for effective deprotection of the acid-labile moieties.

More particularly, preferred polymers comprise esters of bridged alicyclic groups that can stabilize a carbocation intermediate generated during a deprotection  
25 reaction. Isobornyl methacrylate units are particularly preferred. Without wishing to be bound by theory, such isobornyl units are believed to form an intermediate during the deprotection reaction that includes a delocalized carbocation as exemplified in the following Scheme I:

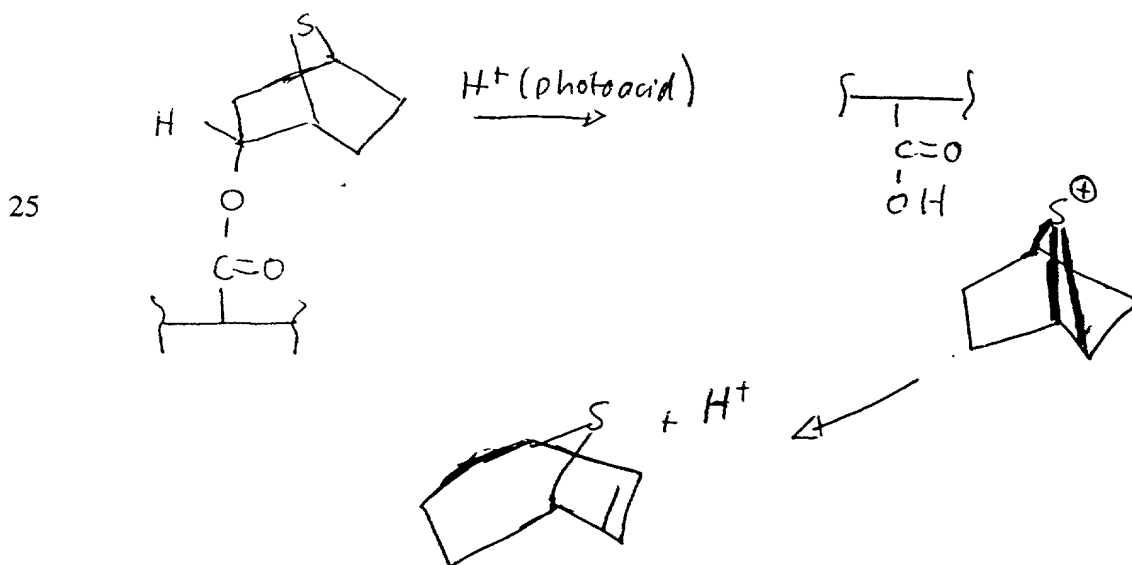
Scheme I



Esters of heteroatom-containing alicyclic groups are also preferred, particularly bridged heteroalicyclic groups as exemplified by the thionorbornyl and oxonorbornyl derivatives depicted in the following Schemes II and III. Again, without wishing to be bound by theory, thio derivatives as exemplified in Scheme II are believed to be capable of forming a stabilized sulfonium ion derivative, and oxo derivatives as exemplified in Scheme III are believed to be capable of forming a stabilized oxonium ion intermediate.

It also should be appreciated that geometric relationships can be essential, e.g. the thionorbornyl group should be in the endo form shown in Scheme II to facilitate the photoacid-induced cleavage reaction.

Scheme II





15

20



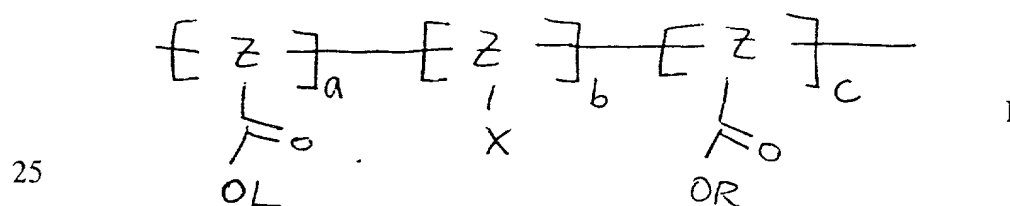
Again without being bound by theory, it is believed the groups shown in Scheme IV above form a single stabilized allylic cation intermediate upon reaction of the acid labile group with photogenerated acid, thereby lowering the energy required to effect the deprotection reaction and enhancing the reaction rate. In Scheme IV above, the



depicted  $R^1$ ,  $R^2$  and  $R^3$  groups suitably may be e.g. independently hydrogen; optionally substituted alkyl such as  $C_{1-6}$  alkyl, more preferably  $C_{1-3}$  alkyl, particularly methyl or ethyl; and the like; and x may be 0 or 1.

5 As mentioned, polymers of the invention may suitably contain other units in addition to the above-discussed acid labile esters. For instance, polymers of the invention may contain units that are essentially unreactive under typical lithographic processing of a photoresist containing the polymer as a resin binder component. Thus, for instance, polymers of the invention may suitably include pendant substituted and  
10 unsubstituted alicyclic groups such as alicyclic groups having 5 to about 18 carbons, e.g. substituted or unsubstituted isobornyl, norbornyl, 2-methyladamantyl, cyclohexyl, etc. As discussed above, for polymers used in photoresists imaged with short wavelength radiation (e.g. less than about 200 nm such as 193 nm), aromatic groups are less preferred because they decrease transparency of a resist. Polymers of the invention  
15 also may include units of other pendant groups such as pendant nitrile groups. The polymers of the invention also may comprise other acid labile groups such as alkyl esters e.g. t-butyl oxycarbonyl groups or cyclohexylcarbonyl groups, or acetate-type acid labile groups as disclosed in U.S. Patent 5,258,257 to Sinta et al.

20 More specifically, suitable copolymers of the invention include those of the following formula I:



wherein L is a stabilizing portion of a photoacid-labile group as discussed above such as optionally substituted isobornyl, fenchyl, pinenyl, 3,2,0 bridged-system, 2,2,1-  
30 bridged system, heteroalicyclic (e.g. having 1 to 3 ring members and 1 to 3 ring

members such as the groups exemplified in Schemes II and III above), small ring alicyclic or alkenyl (such as  $-(CH_2)_{1 \text{ or } 2}-CH=CH_2$ );

X is nitrile; optionally substituted alicyclic typically having 3 to about 8 carbons such as isobornyl, norbornyl, adamantyl, cyclohexyl or cyclohexanone; optionally substituted heteroalicyclic such as tetrahydropyranyl, tetrahydrofuranyl and the like; optionally substituted alkyl, typically having from 1 to about 10 carbons; etc.

R is optionally substituted alkyl, preferably having from 1 to about 20 carbons, more preferably 1 to about 15 carbons; optionally substituted alkenyl, preferably having from 2 to about 20 carbons, more preferably having from 2 to about 15 carbons; optionally substituted alkynyl, preferably having from 2 to about 20 carbons, more preferably having from 2 to about 15 carbons; optionally substituted alkanoyl, preferably having from 1 to about 20 carbons, more preferably having from 1 to about 8 carbons; or optionally substituted heterocyclic having 1 to 3 ring members and 1 to about 3 hetero atoms such as tetrahydrofuranyl, tetrahydropyranyl, piperidinyl or pyrrolidinyl; and the like;

Z is a bridge group between polymer units, e.g. alkylene preferably having 1 to about 6 carbon atoms, more typically 1 to about 3 carbons and optionally substituted by alkyl having 1 to about 3 carbons, halogen, etc.; and

a, b and c are the mole fractions or percents of the respective polymer units.

Generally, a is in a range of from 1 to 100 percent, and b and c each independently vary from 0 to about 99 percent. Typically, a copolymer of the invention will contain at least about 2 to 3 mole percent of units with an L group, more typically at least 5 mole percent of such units.

Preferred polymers of Formula I include those where the only polymer units correspond to the general structures depicted in the Formula, where the sum of a, b and c is about 100 percent. However, preferred copolymers also may comprise additional units wherein the sum of such mole fractions would be less than one hundred.

The above-mentioned optionally substituted groups (including substituted groups L, R, Z, R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> moieties) may be substituted at one or more available positions by one or more suitable groups such as halogen (particularly F, Cl or Br); C<sub>1-12</sub> alkyl; C<sub>1-12</sub> alkoxy; C<sub>2-12</sub> alkenyl; C<sub>2-12</sub> alkynyl; aryl such as phenyl; alkanoyl, e.g. a C<sub>1-12</sub> alkanoyl such as acyl; nitro; cyano; and the like. Typically a substituted moiety is substituted at one, two or three available positions.

In the above formula, Z groups suitably will be substituted or unsubstituted alkylene preferably having 1 to about 10 carbon atoms, more typically 1 to about 6 carbons, or more preferably 1 to about 3 carbons and optionally substituted by alkyl having 1 to about 3 carbons, or Z is a substituted or unsubstituted alkenyl or alkynyl, preferably having 2 to about 10 carbons and optionally substituted by alkyl having 1 to about 3 carbons. Preferred Z groups include ethylene optionally substituted by C<sub>1-3</sub> alkyl such as methyl.

In the formula, it will be understood that alkyl, alkenyl and alkynyl each may be cyclic or straight or branched non-cyclic chains, unless otherwise specified. Exemplary cyclic groups include cyclohexyl, isobornyl, norbornyl, adamantyl and the like. Suitable heterocyclic L groups of formula I include isobornyl, norbornyl, adamantyl and the like that contain a N, O or S atom, particularly O or S atom, as a ring member such as thionorbornyl and oxonorbornyl depicted in Schemes II and III above. In certain preferred embodiments of the invention, polymers of the invention include those that comprise acid-labile groups (including, L with reference to formula I defined above) that contain essentially any alicyclic group, generally having from 5 to about 20 carbons, but with the exclusion of adamantyl, norbornyl, cyclohexyl and/or a tricyclic [5.2.1.0] decane skeleton.

Polymers of the invention can be prepared by a variety of methods. One suitable method is free radical polymerization, e.g., by reaction of a plurality of monomers to provide the various units as discussed above in the presence of a radical initiator under

an inert atmosphere (e.g., N<sub>2</sub> or argon) and at elevated temperatures such as about 50°C or greater, although reaction temperatures may vary depending on the reactivity of the particular reagents employed and the boiling point of the reaction solvent (if a solvent is employed). For example, for synthesis of an isobornyl ester polymer, isobornyl  
5 methacrylate or isobornyl acrylate can be polymerized under free radical conditions, e.g. in refluxing isopropanol in the presence of a free radical initiator such as 2,2'-azobisisobutyronitrile. For synthesis of a polymer containing esters of a 2,2,1-bridged system, suitable monomers for polymerization include (1-oxybicyclo 2,2,1 heptanyl)-4-methacrylate and (7-thiabicyclo 2,2,1 heptanyl) 2-methacrylate. Additional monomers  
10 (such as monomers containing alicyclic groups, monomers that contain nitrile groups or monomers containing other acid labile groups such as t-butyl or other alkyl acrylate units) can be copolymerized to provide the desired polymer. Such other monomers include e.g. optionally substituted vinyladamantane, vinylisobornyl, vinylnorbornyl, isobornylmethacrylates, adamantylmethacrylates, oxocyclohexyl methacrylate,  
15 methacrylonitrile, acrylonitrile, t-butyl acrylate, t-butyl methacrylate, methacrylic acid, itaconic anhydride, etc.

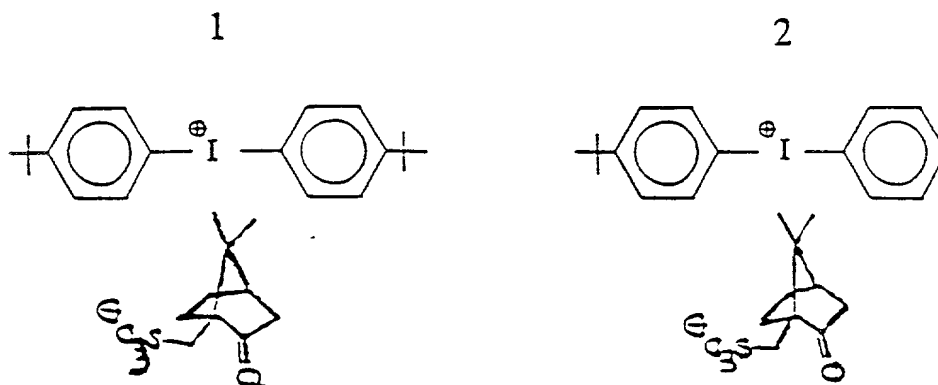
Suitable reaction temperatures to conduct a free radical polymerization for any particular system can be readily determined empirically by those skilled in the art based  
20 on the present disclosure. A reaction solvent may be employed if desired. Suitable solvents include ketones such as acetone, alcohols such as propanols and butanols, aromatic solvents such as benzene, chlorobenzene, toluene and xylene, and ethers such as tetrahydrofuran. Dimethylsulfoxide and dimethylformamide are also suitable. The polymerization reaction also may be run neat. A variety of free radical initiators may be  
25 employed to prepare the polymers of the invention. For example, azo compounds may be employed such as 2,2'-azobis-2,4-dimethyl-pentanenitrile, 2,2'-azobisisobutyronitrile (AIBN) and 1,1'-azobis (cyclohexanecarbonitrile). Peroxides, peresters, peracids and persulfates also can be employed. See the examples which follow for exemplary conditions.

Preferably a polymer of the invention will have a weight average molecular weight (Mw) of 1,000 to about 100,000, more preferably about 2,000 to about 30,000 with a molecular weight distribution (Mw/Mn) of about 3 or less, more preferably a molecular weight distribution of about 2 or less. Molecular weights (either Mw or Mn) of the polymers of the invention are suitably determined by gel permeation chromatography.

As discussed above, polymers of the invention are highly useful as the resin binder component in chemically-amplified positive resists. Photoresists of the invention in general comprise a photoactive component and a resin binder component that contains the above-described polymer.

The resin binder component should be used in an amount sufficient to render a coating layer of the resist developable with an aqueous alkaline developer.

The resist compositions of the invention also comprise a photoacid generator (i.e. "PAG") that is suitably employed in an amount sufficient to generate a latent image in a coating layer of the resist upon exposure to activating radiation. Generally, sulfonate compounds are preferred PAGs, particularly sulfonate salts. Two specifically preferred agents are the following PAGS 1 and 2:



Such sulfonate compounds can be prepared as disclosed in European Patent Application 9611811.2 (publication number 0783136). Briefly, PAG 1 can be

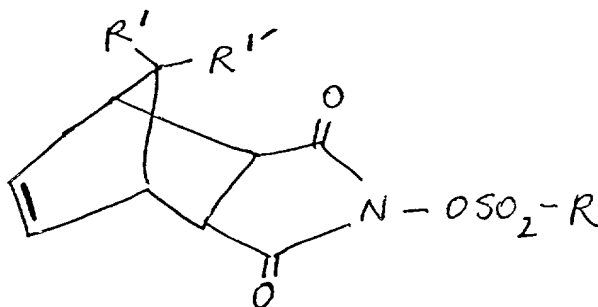
prepared by reaction of a mixture of potassium iodate, *t*-butylbenzene and acetic anhydride with sulfuric acid added dropwise to the mixture with ice-bath cooling. The reaction mixture is then stirred at room temperature for approximately 22 hours, water added with cooling to about 5-10°C and then washing with hexane. The aqueous solution of diaryliodonium hydrogensulfate is then cooled to 5-10°C and then (+/-)-10-camphorsulfonic acid added followed by neutralization with ammonium hydroxide. Sulfonate PAG 2 above can be prepared by those same procedures, except approximately molar equivalents of *t*-butyl benzene and benzene would be reacted together in the first step with acetic anhydride and KIO<sub>3</sub>.

10

Also preferred are the above two iodonium compounds complexed with other counter anions than the above-depicted camphorsulfonate groups. In particular, preferred counter anions include those of the formula RSO<sub>3</sub><sup>-</sup> where R is adamantane, alkyl (e.g. C<sub>1-12</sub> alkyl) and perfluoroalkyl such as perfluoro (C<sub>1-12</sub>alkyl), particularly perfluoro counter anions of perfluorooctanesulfonate, perfluorononylsulfonate and the like.

Other suitable sulfonate PAGS including sulfonated esters and sulfonyloxy ketones. See *J. of Photopolymer Science and Technology*, 4(3):337-340 (1991), for disclosure of suitable sulfonate PAGS, including benzoin tosylate, *t*-butylphenyl alpha-(*p*-toluenesulfonyloxy)-acetate and *t*-butyl alpha-(*p*-toluenesulfonyloxy)-acetate. Preferred sulfonate PAGs are also disclosed in U.S. Patent 5,344,742 to Sinta et al.

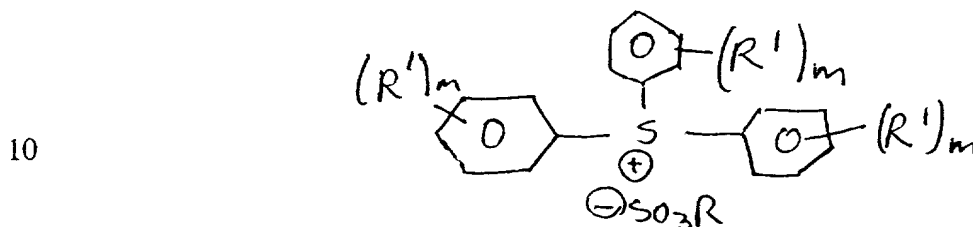
Further preferred PAGS include imidosulfonates such as compounds of the following formula:



wherein each  $R^1$  and  $R^1$  are each independently hydrogen or  $C_{1-12}$  alkyl, more preferably hydrogen or methyl; and R is as defined above, i.e. camphor, adamantane, alkyl (e.g.  $C_{1-12}$  alkyl) and perfluoroalkyl such as perfluoro( $C_{1-12}$ alkyl), particularly perfluoro counter anions of perfluorooctanesulfonate, perfluorononylsulfonate and the like.

5

Triphenylsulfonium salts are also preferred PAGS for use in the photoresists of the invention, including compounds of the following formula:



wherein each  $R^1$  is independently hydrogen or  $C_{1-12}$  alkyl; each m is independently an integer of from 0 to 5, and preferably each m is 0, 1 or 2 ; and R is as defined above, i.e. camphor, adamantane, alkyl (e.g.  $C_{1-12}$  alkyl) and perfluoroalkyl such as  
 15 perfluoro( $C_{1-12}$ alkyl), particularly perfluoro counter anions of perfluorooctanesulfonate, perfluorononylsulfonate and the like.

Other known PAGS also may be employed in the resists of the invention.

20 A preferred optional additive is an added base, particularly tetrabutylammonium hydroxide (TBAH), or a lactate salt of TBAH, which can enhance resolution of a developed resist relief image. The added base is suitably used in relatively small amounts, e.g. about 0.01 to 5 percent by weight relative to the photoactive component (PAG).

25

Photoresists of the invention also may contain other optional materials such as anti-striation agents, plasticizers, speed enhancers, etc. Such optional additives typically will be present in minor concentration in a photoresist composition except for fillers and dyes which may be present in relatively large concentrations such as, e.g., in  
 30 amounts of from about 5 to 30 percent by weight of the total weight of a resist's dry

components.

The compositions of the invention can be readily prepared by those skilled in the art. For example, a photoresist composition of the invention can be prepared by dissolving the components of the photoresist in a suitable solvent such as, for example, ethyl lactate, a glycol ether such as 2-methoxyethyl ether (diglyme), ethylene glycol monomethyl ether, ethylene glycol monomethyl ether, propylene glycol monomethyl ether; and 3-ethoxy ethyl propionate. Typically, the solids content of the composition varies between about 5 and 35 percent by weight of the total weight of the photoresist composition. The resin binder and PAG components should be present in amounts sufficient to provide a film coating layer and formation of good quality latent and relief images. See the examples which follow for exemplary preferred amounts of resist components.

The compositions of the invention are used in accordance with generally known procedures. The liquid coating compositions of the invention are applied to a substrate such as by spinning, dipping, roller coating or other conventional coating technique. When spin coating, the solids content of the coating solution can be adjusted to provide a desired film thickness based upon the specific spinning equipment utilized, the viscosity of the solution, the speed of the spinner and the amount of time allowed for spinning.

The resist compositions of the invention are suitably applied to substrates conventionally used in processes involving coating with photoresists. For example, the composition may be applied over silicon or silicon dioxide wafers for the production of microprocessors and other integrated circuit components. Aluminum-aluminum oxide, gallium arsenide, ceramic, quartz or copper substrates also may be employed. Substrates used for liquid crystal display and other flat panel display applications are also suitably employed, e.g. glass substrates, indium tin oxide coated substrates and the like.



Following coating of the photoresist onto a surface, it is dried by heating to remove the solvent until preferably the photoresist coating is tack free. Thereafter, it is imaged through a mask in conventional manner. The exposure is sufficient to effectively activate the photoactive component of the photoresist system to produce a  
5 patterned image in the resist coating layer and, more specifically, the exposure energy typically ranges from about 1 to 300 mJ/cm<sup>2</sup>, dependent upon the exposure tool and the components of the photoresist composition.

Coating layers of the resist compositions of the invention are preferably  
10 photoactivated by an exposure wavelength in the deep U.V. range i.e., 350 nm or less, more typically in the range of about 300 nm or less, typically about 150 to 300 or 450 nm. A particularly preferred exposure wavelength is about 248 nm. As discussed above, polymers of the invention also will be useful for resists imaged at wavelengths less than about 200 nm, such as 193 nm

15

Following exposure, the film layer of the composition is preferably baked at temperatures ranging from about 70°C to about 160°C. Thereafter, the film is developed. The exposed resist film is rendered positive working by employing a polar developer, preferably an aqueous based developer such as an inorganic alkali  
20 exemplified by sodium hydroxide, potassium hydroxide, sodium carbonate, sodium bicarbonate, sodium silicate, sodium metasilicate; quaternary ammonium hydroxide solutions such as a tetra-alkyl ammonium hydroxide solution; various amine solutions such as ethyl amine, n-propyl amine, diethyl amine, di-n-propyl amine, triethyl amine, or methyldiethyl amine; alcohol amines such as diethanol amine or triethanol amine;  
25 cyclic amines such as pyrrole, pyridine, etc. In general, development is in accordance with art recognized procedures.

Following development of the photoresist coating over the substrate, the developed substrate may be selectively processed on those areas bared of resist, for  
30 example by chemically etching or plating substrate areas bared of resist in accordance

with procedures known in the art. For the manufacture of microelectronic substrates, e.g., the manufacture of silicon dioxide wafers, suitable etchants include a gas etchant, e.g. a chlorine or fluorine-based etchant such a  $\text{CF}_4$  or  $\text{CF}_4/\text{CHF}_3$  etchant applied as a plasma stream. After such processing, resist may be removed from the processed

5 substrate using known stripping procedures.

All documents mentioned herein are fully incorporated herein by reference. The following non-limiting examples are illustrative of the invention.

10 Example 1 - Polymer synthesis

A 500 ml three necked round bottomed flask is charged with monomers as specified below in Table 1 along with 150 g tetrahydrofuran and fitted with a pressure-equalizing dropping funnel, a water cooled reflux condenser and rubber septa on both the dropping funnel and the flask. The top of the reflux condenser is fitted with an oil

15 bubbler to prevent backflow of air. The monomer charge is purged by bubbling dry nitrogen through the solution for 15 minutes. The dropping funnel is charged with 100 g tetrahydrofuran and 4.2 g (17 mmol) pentanitride, 2,4-dimethyl, 2,2'-azobis initiator and purged with dry nitrogen as above. Once the nitrogen purges are completed the monomer mixture is heated to reflux and the initiator solution is added slowly over 20

20 minutes. The entire solution is held at reflux for 14 hours. The resultant polymer solution is precipitated in hexane and dried according to standard procedures.

TABLE I

Monomer	Mass of Charge, g	Moles of Charge
Isobornyl methacrylate	40	0.18
exo(7-thiabicyclo 2,2,1 heptanyl) 2-methacrylate	30	0.15
Itaconic Anhydride	15	0.13
Methacrylic Acid	5	0.06
Methacrylonitrile	10	0.15

Example 2 - Polymer synthesis

The same reaction is performed as in Example 1 except with the monomer charge given in Table 2.

TABLE 2

Monomer	Mass of Charge, g	Moles of Charge
Isobornyl methacrylate	40	0.18
endo(1-oxybicyclo 2,2,1 heptanyl) 4-methacrylate	30	0.16
Itaconic Anhydride	15	0.13
Methacrylic Acid	5	0.06
Methacrylonitrile	10	0.15

5

Example 3 - Photoresist preparation and processing

A photoresist composition of the invention is prepared by mixing the following components with amounts expressed as weight percents based on total weight of the

10 resist composition.

<u>Resist Components</u>	<u>Amount (wt. %)</u>
Resin Binder	15
Photoacid Generator	4
Ethyl Lactate	81

15

The resin binder is the copolymer formed in Example 1 above and the photoacid generator is di-(4-t-butylphenyl)iodonium (+/-)-10-camphor sulfonate (PAG 1 above).

The photoresist composition is spin coated onto HMDS vapor primed 4 inch  
20 bare silicon wafers and softbaked via a vacuum hotplate at 120°C for 60 seconds. The resist coating layers are exposed through a photomask at 193 nm, and then silicon wafers are post-exposure baked (PEB) at about 110°C. The wafers are treated with 0.26 N aqueous tetramethylammonium hydroxide solution to provide a relief image.

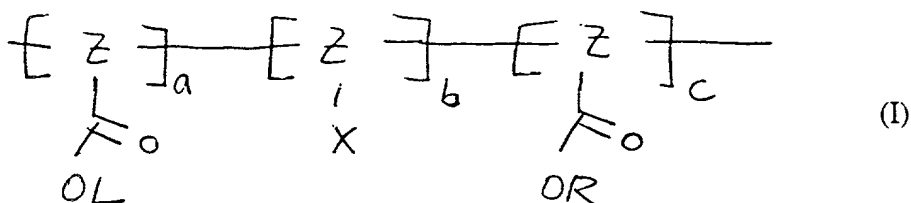
The foregoing description of the invention is merely illustrative thereof, and it is understood that variations and modification can be made without departing from the spirit or scope of the invention as set forth in the following claims.

1. A method of determining the presence of a target nucleic acid in a sample, comprising the steps of: (a) amplifying a portion of the target nucleic acid in the sample to form a target amplification product; (b) hybridizing the target amplification product with a probe; and (c) detecting the presence of the target amplification product.

What is claimed is:

1. A positive-acting photoresist composition comprising a photoactid generator compound and a polymer that is substantially free of aromatic groups and that comprises pendant acid-labile groups that contain an optionally substituted isobornyl group, optionally substituted fenchyl, optionally substituted pinenyl, an optionally substituted 3,2,0 bridged-system, an optionally substituted 2,2,1-bridged system, optionally substituted heteroalicyclic group, optionally substituted cycloalkyl group having 3 or 4 ring carbon atoms, or optionally substituted alkenyl group.
2. A photoresist composition of claim 1 wherein the acid-labile groups comprise an optionally substituted isobornyl group.
3. A photoresist composition of claim 1 wherein the acid-labile groups comprise an optionally substituted heteroalicyclic group which upon reaction with photogenerated acid cleaves to form a stabilized delocalized cationic intermediate.
4. A photoresist composition of claim 1 wherein the acid-labile groups comprise an optionally substituted cycloalkyl group having 3 or 4 ring carbon atoms.
5. A photoresist composition of claim 1 wherein the acid-labile groups comprise an optionally substituted alkenyl group.
6. A photoresist composition of claim 5 wherein the alkenyl group is of the formula  $-(CH_2)_{1 \text{ or } 2}-CH=CH_2$  and may be optionally substituted at available positions.

7. A photoresist composition of claim 1 wherein the polymer comprises repeating units corresponding to the following formula I:



wherein L is optionally substituted isobornyl group, optionally substituted fenchyl, optionally substituted pinenyl, an optionally substituted 3,2,0 bridged-system, an optionally substituted 2,2,1-bridged system, optionally substituted heteroalicyclic group, optionally substituted cycloalkyl group having 3 or 4 ring carbon atoms, or optionally substituted alkenyl group;

X is nitrile, optionally substituted alicyclic group, optionally substituted heteroalicyclic group, optionally substituted alkyl, optionally substituted alkenyl or optionally substituted alkynyl;

R is optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted alkanoyl, or optionally substituted or unsubstituted heterocyclic having 1 to 3 ring members and 1 to about 3 hetero atoms;

Z is a bridge group between polymer units; and a, b and c are the mole percents of the respective polymer units.

8. A positive-acting photoresist composition comprising a photoacid generator compound and a polymer that is substantially free of aromatic groups and that comprises pendant acid-labile groups that have an anchimeric assistance value A that is greater than the anchimeric assistance value A provided by pendant polymer moieties of  $-\text{C}(=\text{O})\text{Oadamantyl}$ ,  $-\text{C}(=\text{O})\text{Onorbornyl}$ , or  $-\text{C}(=\text{O})\text{O cyclohexyl}$ .

9. A method for forming a positive photoresist relief image, comprising:  
a) applying a coating layer of a photoresist composition of claim 1 on a substrate; and  
b) exposing and developing the photoresist coating layer to yield a positive tone relief image.

10. A method of claim 9 wherein the photoresist coating layer is exposed with radiation of a wavelength of less than about 250 nm.

11. A method of claim 9 wherein the photoresist coating layer is exposed with radiation of a wavelength of less than about 200 nm.

12. A method of claim 9 wherein the photoresist is exposed with radiation of a wavelength of about 248 nm or 193 nm.

13. A method for forming a positive photoresist relief image, comprising:  
a) applying a coating layer of a photoresist composition of claim 8 on a substrate; and  
b) exposing and developing the photoresist coating layer to yield a positive tone relief image.

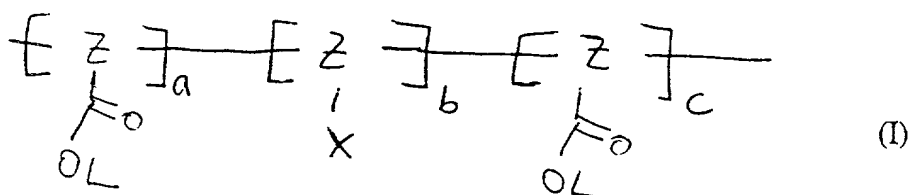
14. An article of manufacture comprising a substrate having coated thereon the photoresist composition of claim 1.

15. The article of claim 14 wherein the substrate is a microelectronic wafer or a flat panel display substrate.

16. An article of manufacture comprising a substrate having coated thereon the photoresist composition of claim 8.

17. The article of claim 16 wherein the substrate is a microelectronic wafer or a flat panel display substrate.

18. A polymer that comprises repeating units corresponding to the following Formula I:



wherein L is optionally substituted isobornyl group, optionally substituted fenchyl, optionally substituted pinenyl, an optionally substituted 3,2,0 bridged-system, an optionally substituted 2,2,1-bridged system, optionally substituted heteroalicyclic group, optionally substituted cycloalkyl group having 3 or 4 carbon atoms, or optionally substituted alkenyl group;

X is nitrile, optionally substituted alicyclic group, optionally substituted heteroalicyclic group, optionally substituted alkyl, optionally substituted alkenyl or optionally substituted alkynyl;

R is optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted alkanoyl, or optionally substituted heterocyclic having 1 to 3 ring members and 1 to about 3 hetero atoms;

Z is a bridge group between polymer units; and a, b and c are the mole percents of the respective polymer units.



The present invention provides novel polymers and chemically-amplified positive-acting photoresist compositions that contain such polymers as a resin binder component. Preferred polymers of the invention include one or more structural groups that are capable of reducing the temperature required for effective deprotection of acid-labile moieties of the polymer.

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**COMBINED DECLARATION AND POWER OF ATTORNEY**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,  
CONTINUATION, OR C-I-P)

---

As a below named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type:

(check one applicable item below)

- ☒ original.  
☐ design.  
☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT.

NOTE If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P

NOTE See 37 C.F.R. § 1.63(d) (continued prosecution application) for use of a prior nonprovisional application declaration in the continuation or divisional application being filed on behalf of the same or fewer of the inventors named in the prior application.

- ☐ divisional.  
☐ continuation.

NOTE: Where an application discloses and claims subject matter not disclosed in the prior application, or a continuation or divisional application names an inventor not named in the prior application, a continuation-in-part application must be filed under 37 C.F.R. § 1.53(b) (application filing requirements — nonprovisional application).

- ☐ continuation-in-part (C-I-P).

**INVENTORSHIP IDENTIFICATION**

**WARNING:** If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

**TITLE OF INVENTION**

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**NOVEL POLYMERS AND PHOTORESIST COMPOSITIONS**

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(Declaration and Power of Attorney [1-1]—page 1 of 7)

## SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b), or (c))

(a) ☐ is attached hereto.

NOTE: "The following combinations of information supplied in an oath or declaration filed on the application filing date with a specification are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(1) name of inventor(s), and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration on filing;

"(2) name of inventor(s), and attorney docket number which was on the specification as filed; or

"(3) name of inventor(s), and title which was on the specification as filed "

Notice of July 13, 1995 (1177 O G 60)

(b) ☒ was filed on November 4, 1997, as ☒ Serial No. 08 / 963,922  
or ☐ \_\_\_\_\_  
and was amended on \_\_\_\_\_ (if applicable).

NOTE Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

NOTE "The following combinations of information supplied in an oath or declaration filed after the filing date are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63.

"(1) name of inventor(s), and application number (consisting of the series code and the serial number; e.g., 08/123,456);

"(2) name of inventor(s), serial number and filing date,

"(3) name of inventor(s) and attorney docket number which was on the specification as filed,

"(4) name of inventor(s), title which was on the specification as filed and filing date;

"(5) name of inventor(s), title which was on the specification as filed and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration; or

"(6) name of inventor(s), title which was on the specification as filed and accompanied by a cover letter accurately identifying the application for which it was intended by either the application number (consisting of the series code and the serial number; e.g., 08/123,456), or serial number and filing date. Absent any statement(s) to the contrary, it will be presumed that the application filed in the PTO is the application which the inventor(s) executed by signing the oath or declaration."

Notice of July 13, 1995 (1177 O G 60)

(c) ☐ was described and claimed in PCT International Application No. \_\_\_\_\_, filed on \_\_\_\_\_ and as amended under PCT Article 19 on \_\_\_\_\_ (if any).

**SUPPLEMENTAL DECLARATION (37 C.F.R. § 1.67(b))**

*(complete the following where a supplemental declaration is being submitted)*

- ☐ I hereby declare that the subject matter of the
- ☐ attached amendment
  - ☐ amendment filed on \_\_\_\_\_

was part of my/our invention and was invented before the filing date of the original application, above-identified, for such invention.

**ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR**

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

*(also check the following items, if desired)*

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

**PRIORITY CLAIM (35 U.S.C. §§ 119(a)-(d))**

NOTE: "The claim to priority need be in no special form and may be made by the attorney or agent if the foreign application is referred to in the oath or declaration as required by § 1.63. The claim for priority and the certified copy of the foreign application specified in 35 U.S.C. 119(b) must be filed in the case of an interference (§ 1.630), when necessary to overcome the date of a reference relied upon by the examiner, when specifically required by the examiner, and in all other situations, before the patent is granted. If the claim for priority or the certified copy of the foreign application is filed after the date the issue fee is paid, it must be accompanied by a petition requesting entry and by the fee set forth in § 1.17(f). If the certified copy is not in the English language, a translation need not be filed except in the case of interference; or when necessary to overcome the date of a reference relied upon by the examiner; or when specifically required by the examiner, in which event an English language translation must be filed together with a statement that the translation of the certified copy is accurate." 37 C.F.R. § 1.55(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

*(complete (d) or (e))*

- (d) ☒ no such applications have been filed.
- (e) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION  
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)**  
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER

FILING DATE

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_ / \_\_\_\_\_

\_\_\_\_\_

**CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)  
UNDER 35 U.S.C. 120**

- ☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN PART (C-I-P) APPLICATION.

**ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

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NOTE If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

**POWER OF ATTORNEY**

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

*(list name and registration number)*

Principal Attorney:

Robert L. Goldberg  
(Reg. No. 22456)

Please recognize as Associate Attorneys:

Peter F. Corless (Reg. No. 33860); and  
Ernest V. Linek (Reg. No. 29822)

*(check the following item, if applicable)*

- ☐ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- ☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

☒ Address

Robert L. Goldberg, Esq.  
P.O. Box 556  
Marlborough, MA 01752

DIRECT TELEPHONE CALLS TO:  
*(Name and telephone number)*

Robert L. Goldberg, Esq.  
(508) 485-7772

☐ Customer Number \_\_\_\_\_

## DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

<u>Gary</u> (GIVEN NAME)	<u>N.</u> (MIDDLE INITIAL OR NAME)	<u>Taylor</u> FAMILY (OR LAST NAME)
Inventor's signature <u>Gary N. Taylor</u>		
Date <u>March 24, 1998</u> Country of Citizenship <u>U.S.A.</u>		
Residence <u>803 Applebriar Lane, Marlborough, MA 01752</u>		
Post Office Address <u>Same</u>		

Full name of second joint inventor, if any

<u>Charles</u> (GIVEN NAME)	<u>R.</u> (MIDDLE INITIAL OR NAME)	<u>Szmanda</u> FAMILY (OR LAST NAME)
Inventor's signature <u>Charles R. Szmanda</u>		
Date <u>3/23/98</u> Country of Citizenship <u>U.S.A.</u>		
Residence <u>4 Crossman Avenue, Westborough, MA 01581</u>		
Post Office Address <u>4 Crossman Avenue, Westborough, MA 01581</u>		

Full name of third joint inventor, if any

<u></u> (GIVEN NAME)	<u></u> (MIDDLE INITIAL OR NAME)	<u></u> FAMILY (OR LAST NAME)
Inventor's signature _____		
Date _____ Country of Citizenship _____		
Residence _____		
Post Office Address _____		

(check proper box(es) for any of the following added page(s)  
that form a part of this declaration)

- ☐ **Signature** for fourth and subsequent joint inventors. *Number of pages added* \_\_\_\_\_

. . .

- ☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* \_\_\_\_\_

. . .

- ☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* \_\_\_\_\_

. . .

- ☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

. . .

- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added \_\_\_\_\_

. . .

- ☐ Authorization of practitioner(s) to accept and follow instructions from representative.

. . .

(if no further pages form a part of this Declaration,  
then end this Declaration with this page and check the following item)

- ☒ This declaration ends with this page.